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ABSTRACT

Comprehension of film was studied in an ATI (aptitude x treatment interaction) framework which investigated comprehension as a function of the interaction of the stimulation-seeking motive (arousal) and degree of structure in information presented in film. Three levels of organizational coherence of a short film and two levels of the stimulation seeking motive (high stimulation-seekers vs. low stimulation-seekers) were employed with 80 undergraduate students. Comprehension was measured for both verbal and pictorial stimuli and literal and inferential processing. No significant main or interaction effects were obtained. However, correlational analyses suggested a possible moderating effect of the stimulation-seeking motive (arousal) on the relationship among memory or information processing systems, indicating perhaps differential encoding or information processing strategies between groups high and low in the stimulation-seeking motive. Such a possible moderating effect should be the focus of further investigation. (Author)

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Arousal and Cognition: The Stimulation-Seeking Motive and Structural Effects in the Comprehension of Film

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Arousal and Cognition: The Stimulation-Seeking Motive and Structural Effects in the Comprehension of Film

The concept of physiological arousal as a partial determinant of behavior has been referred to by many researchers in several terminologies. They have spoken of "complexity level" (Dember & Earl, 1957), "activation level" (Berlyne, 1960; Farley, Note 3; Maddi, 1961; Malmo, 1959), "excitation level" (Hebb & Thompson, 1954), etc. Some of the available models have in common the idea that a human being or other mammal experiences a degree of general physiological excitation at any given time and will actively pursue in its environment those activities or situations needed to raise or lower this excitation to some optimal level, which lies somewhere in the intermediate range of possible values.

It has been argued that the level of arousal depends jointly on the external environmental factors impinging on the organism through its sense organs and its own internal state, with the two factors aggregating to a general level (Duffy, 1957; Leuba, 1962; Farley, Note 3). The internal mediator of arousal or activation seems to be the reticular activating system (RAS) (Malmo, 1962; Farley, Note 3; Berlyne, 1960), a brain stem structure that apparently maintains the organism's general alertness level.

The interaction between level of RAS-mediated arousal and behavioral efficiency has been proposed as following an inverted U-shaped function (Duffy, 1957; Farley, Note 3; Malmo, 1959), with intermediate levels producing most effective performance and excessively high or low levels being detrimental to performance.

Although an individual's RAS-mediated arousal will vary over a range of levels depending on both internal and external factors, there appears to be a degree of intra-individual stability (Farley, Note 3). It has thus been proposed that an individual has a characteristic or "intrinsic level of arousal" (Farley, Note 2, Note 3). The individual will try to optimize his RAS-mediated arousal level through his interactions with the environment, and since the former exhibits a degree of consistency, the behavioral correlate, stimulation-seeking, will take on characteristic trait-like patterns. Those people low in intrinsic arousal will seek stimulation in their environment and those high in intrinsic arousal will seek to avoid stimulation, in both cases the objective being the attainment of the optimal median level. The relation between arousal and stimulation-seeking behavior is thus conceived of as a negative linear function.

The personality trait of stimulation-seeking can be measured by the Sensation-Seeking Scale (SSS; Zuckerman, Kolin, Price, & Zoob, (1964) a 22-item forced-choice questionnaire which estimates a factor known as general sensation-seeking activity, or a number of other inventories and performance tasks (Farley, 1971). A review by Zuckerman (1971) indicates that sensation-seeking tendency correlates positively with preference for complexity and tolerance for ambiguity, and negatively with orderliness. Farley (1971) found that the SSS correlates significantly with other measures of the tendency toward variety, the Change-Seeker Index (Garlington & Shimota, 1964), the Similes Preference Inventory (Pearson & Maddi, 1966), and a measure of the production of novel work completions.

It was hypothesized that in a learning or instructional situation the following attributes would be arousing and would appeal to high sensation-seekers: complexity, ambiguity, inconsistency, and lack of structure, among others (Farley, Note 3). Rautman and Farley (Note 4) obtained support for

this hypothesized interaction of arousal and instructional method, finding that for a problem-solving task, high arousal subjects showed more effective performance with an expository instruction format while low arousal subjects performed better with a discovery format.

The RAS arousal construct has been explored to varying degrees in its relation to laboratory learning and prose learning, learning from aural discourse (Clark & Farley, Note 1) and from slide-tape (Farley & Grant, 1976). As yet only one study (Santiago & Farley, Note 5) has appeared dealing with the relation of arousal to learning from film, and in that study no attempt was made to experimentally vary the nature of the film. The present study attempted to deal with film variation effects, specifically organizational structure, as related to viewers' arousal. Many studies show that learning is facilitated by some degree of organization of the information presented (e.g., Weingartner, 1963; Cunningham, 1971; Tennyson, 1972). It was decided to treat arousal in the form of an aptitude x treatment interaction [ATI, or arousal by treatment interaction (Farley, Note 3)] with intrinsic and environmental (or extrinsic) arousal being used as the two independent variables. The latter was manipulated through varying the inherent degree of structure and organization of the presented material across three conditions.

The film consisted of a series of still photographs interspersed with text, with the conditions of varying structure being achieved through random editing. Pictorial material was combined with text in the film, so that both modes of presentation were available for evaluation of the interaction with arousal. The contextual structure was to vary across the conditions but factors such as speed of editing were to be controlled if possible.

Recall of linguistic information and pictorial imagery was tested for, with the imagery recall requiring a translation into a verbal (written) response. A test for learning through inference was also included, involving information

which presumably required an active process of utilizing several items to draw conclusions beyond the information specifically given in either pictures or words.

Thus the specific prediction was:

There would be an interaction between intrinsic arousal, as measured by the SSS, and situational arousal, as presumably manipulated through the varying degrees of film structure, with the less structured material being more effective with high sensation-seekers than low sensation-seekers, and with the highly structured material showing a superiority of low sensation-seekers over high sensation-seekers. This relation would be found across question types.

Method

Subjects

The subjects were 123 undergraduate students in educational psychology at the University of Wisconsin-Madison. For each film condition, those subjects who scored with the middle third on the SSS were later dropped, so that 80 subjects comprise the bulk of the analyses. Of these, 56 were females, 24 were males. From here on in this text, singular reference to subjects will be made using the pronoun "she", since women comprised the majority of the sample.

Materials

Film.

The film was shot in Super-8 black and white. Black and white was felt to have lower inherent arousal properties than color film (cf. Farley & Grant, 1976). The film ran 5 minutes 22 seconds for the intended projection speed of 18 frames/second. It traced the political history of a fictional island off the coast of Africa. The organizational structure of the subject matter

was represented to a significant extent in the chronological sequencing of the film. The film was comprised of 13 sections, each one consisting of: (a) a paragraph containing one or several sentences pertaining to a specific period or event; these uniformly ran for six seconds; (b) a series of photographs elaborating on the information presented in the paragraph. Each of the 488 photographs was presented for 0.5 second. The lengths of these pictorial sequences varied between 24 pictures (12 seconds) and 55 pictures (27.5 seconds).

Although the paragraph and picture series comprising each section both dealt with the same subtopic, each of the two contained certain items of information unique to itself. In this way it was possible to distinguish to some extent, for each subject, the effectiveness of each mode of information presentation--linguistic and pictorial, as well as the learning inferred from the combination of modes.

Three copies of the film were made and then edited to reflect differing degrees of structure. Condition I, presumably the most highly structured, left the film unaltered. For Condition II the film was cut into its 13 sub-sections, and these were randomly re-ordered and spliced back together. Although the chronological sequencing of the film was disturbed, the presentation format of a statement and its subsequent illustration was left intact, so that a moderate degree of randomness was felt to be attained. For Condition III the film was cut into 3-foot strips, which were then randomly re-ordered and spliced together. There were 27 of these strips, approximately twice as many disconnections as there were in Condition II. In addition to the greater number of re-arranged sections, the disruption of the paragraph-picture series presentation format was thought to lend a further degree of randomness to the film. Three degrees of content structure were thus felt to have been attained.

Learning and comprehension measures.

The test used to assess learning and comprehension contained 25 four-alternative multiple-choice items. These items were constructed according to guidelines suggested by Anderson (1972). Ten of the items referred to information conveyed only in the verbal statements. The questions paraphrased the sentences used. Eight of the items involved pictorial information retention. These items required the subject to identify which one of several objects or activities had been depicted pictorially in the film. The remaining seven items were inference questions, requiring information which was conveyed by the photographs but was not explicitly stated in sentences.

Arousal measure.

The 22-item Sensation-Seeking Scale (Zuckerman, Kolin, Price, & Zoob, 1964) was used. This is a forced-choice paper and pencil test; in each item the subject has to choose which of two alternatives better describes her. Substantial validity and reliability data have been reported (Farley, 1971; Farley & Haubrich, 1974; Zuckerman, 1971). The possible scores range from 0 to 22, with higher scores reflecting higher sensation-seeking.

Procedure

For the film presentation, the subject was brought to the sound-reduced viewing room and seated in a large chair. She was told that she was going to see a film and was requested to pay attention, but was not explicitly told that she would subsequently be tested. The film was projected through a window from an adjoining room so that noise would be reduced to a minimum. It was projected onto the wall facing the subject's chair at a distance of about eight feet from the subject. Subjects were randomly assigned into film conditions I, II, or III; their SSS tests were not scored until the experiment was completed. Immediately after viewing the film the subject was

handed the 25 item multiple-choice retention test. She filled it out in a chair outside the viewing room, while the procedure inside the viewing room was repeated for the next subject.

Results

Subjects were identified on the SSS after all had participated in the experiment. Within each film condition, data for those scoring in the middle third were dropped in order to attain groups more highly differentiated on the arousal dimension. Thus the cells obtained have equal N's across arousal levels but are somewhat unequal across the treatment dimension. Slide 1 presents the N's per cell and the means and standard deviations for each of the various dependent measures.

Show Slide 1 about here

To test for possible effects on the subtest scores, separate 2 x 3 analyses of variance were performed for each of the subtest variables for effects of arousal and film treatment condition, using procedures for proportional cell frequencies. A composite score was also computed which weighted the three tests equally. This was done by summing the percentage right on the three tests for each subject, and multiplying by 100 to promote ease of computation.

The results of the analysis of variance for the inference subtest were as follows: Stimulation-seeking MS = 0.613 (df = 1, 74), F = 0.425 (NS); film structure MS = 0.409 (df = 2, 74), F = 0.284 (NS); interaction MS = 0.597 (df = 2,74), F = 0.413 (NS); error MS = 1.443.

The results of the analysis of variance for the verbal subtest were as follows: Stimulation-seeking MS = 7.813 (df = 1,74), F = 2.068 (NS); film structure MS = 5.642 (df = 2,74). F = 1.493 (NS); interaction MS = 2.232

(df = 2,74), F = 0.591 (NS); error MS = 3.779.

The results of the analysis of variance for the pictorial subtest were as follows: Stimulation-seeking MS = 6.613 (df = 1,74), F = 2.702 (NS); film structure MS = 4.207 (df = 2,74), F = 1.719 (NS); interaction MS = 2.939 (df = 2,74), F = 1.201 (NS); error MS = 2.447.

The results of the analysis of variance for the combined and transformed test were as follows: Stimulation-seeking MS = 2420.00 (df = 1,74), F = 1.50 (NS); film structure MS = 1063.34 (df = 2,74), F = .66 (NS); interaction MS = 1412.72 (df = 2,74), F = .44 (NS); error MS = 1609.91.

Pearson product-moment correlations were computed among the dependent measures, first being computed without regard to independent variable conditions. These results were as follows: correlation of inference subtest with verbal subtest r = .32 ($p < .01$), with pictorial subtest r = .15 (NS); correlation of verbal subtest with pictorial subtest r = .27 ($p < .05$). (These statistics include only the 80 subjects used in the analyses of variance). Comparable correlations to the foregoing were then computed across the film treatment conditions within each of the arousal levels (as presented in Slide 2). The correlations among the subtests indicate that these are interrelated, with only the verbal-pictorial and inferential-

Show Slide 2 about here

pictorial relationships for low stimulation-seekers being non-significant. In addition, intrinsic arousal, as measured by the SSS, appears to act as a moderator (Saunders, 1958) of the interrelatedness among these learning modes. On the basis of this finding correlations were computed between the verbal and pictorial, verbal and inferential, and inferential and pictorial

scores for the entire original sample of 123 subjects tested to see if these were generally related. The correlations obtained were .214 ($p < .05$), .386 ($p < .01$), and .173 ($p < .10$), respectively. To test for the possible moderating effect of arousal on these subtests, significance ratios were computed for differences between matched correlations, for each high and low stimulation-seeking pair, in the three subtest combinations. These statistics, distributed as X^2 with 1 df, are as follows; inference-verbal 0.259; inference-pictorial 1.379; verbal-pictorial 1.767. None of the foregoing was significant at conventional levels.

Discussion

No significant effects were identified by the analyses of variance. The implications of these results are not completely clear. The film that was used was somewhat atypical in its fast editing and large amount of presented information. The quick editing speed was chosen so that the rate would remain constant across the three structure conditions. With a slow paced film, cutting the film 26 times might double or triple the number of individual shots. In this event it could not be claimed that only the content organization was varied. The fast pace was therefore required. The use of stills, eliminating movement, became necessary to accommodate the fast editing. What resulted was stimulus material with a high situational arousal level, and we can say that in this instance stimulation-seeking did not produce an interaction with structure. Generalization to other film presentations is somewhat limited.

The choppy nature of the film seemed also to make its instructional capacity relatively insensitive to structural rearrangement. Evidently it remained a presentation of discrete information bits in all three of its

incarnations. This would account for the failure to find main effects for film structure. This result was probably heightened by the learning measure used. As described previously, a majority of the questions tapped the retention of single, separate items of information, presented both in the linguistic and pictorial modes. A larger number of inference-type questions might point out more distinct differences between film conditions. For the present experiment, the factors discussed probably accounted for the finding of no effects for film structure.

In the consideration of follow-up research, several suggestions can be made. If the stimulus material to be used was again a sequence of still pictures, a slower rate of presentation might yield more discernible effects. Variations in editing rate might also be investigated. Penn (1971) found that accelerated and decelerated editing differentially influenced meaningfulness as measured by a semantic differential scale and an associative measure. He hypothesized that this effect was due to the more rapid change of stimuli accompanying the fast editing, resulting in increased complexity of the material. If so, the meaningfulness variable might be expected to interact with stimulation-seeking. Although Penn did not test for learning outcomes, these could conceivably also be affected. Another variable of interest, not considered in the present study, is the amount of information contained in the individual pictures, e.g., photographs vs. line drawings. Research results to date are unclear, but it seems that generally higher information (e.g., photographs) is superior in those learning tasks requiring the presence of learning cues (such as recognition accuracy), and allowing adequate time for inspection (see Rudnick, Porter, & Suydam, 1973). Arousal or stimulation-seeking behavior could conceivably play a role also in the

relative effectiveness of these conditions.

Possibly the most interesting finding of the present research was that stimulation-seeking differentially affected the interrelatedness of the various subtests. These subtests were significantly correlated (except for the inference-pictorial relation, which barely fell short at the .05 level) across the entire sample, with middle range stimulation-seekers included. It was found, however, that among low stimulation-seekers relationships were not significant between verbal and pictorial scores, or between inferential and pictorial scores. The former relationship is most surprising since those tests both consisted of simple fact items which presumably did not require cognitive manipulation on the viewer's part. Why one should encounter a significant relationship among high stimulation-seekers and no observed relationship among low stimulation-seekers under conditions of high information presentation can only be guessed at here. The answer may lie in encoding processes. The process by which pictorial information is encoded and stored is a subject of some debate. Glanzer and Clark (1964) have proposed a "verbal loop hypothesis" which states that the information is translated into verbal form, stored as such, and retrieved when necessary. Other researchers (Cermak, 1971; den Heyer & Barrett, 1971; Tversky, 1969) favor the existence of a separate iconic memory system in addition to a verbal one. Levie (1973), in providing support for the non-verbal memory mode, has pointed to the ability, in many cases, of making visual distinctions without a corresponding verbal facility. Studies of differential interference immediately following a task (Atwood, 1971) also support the concept of separate systems. Perhaps the high stimulation-seekers use an encoding process involving translation of pictorial information into verbal units, i.e., they encode all information verbally, while the low stimulation-seekers use an iconic

store fore pictorial information. It must be remembered that it was not the mean scores on these measures that showed much difference between stimulation-seeking levels, only the interrelatedness of these scores. A significance test for these differences between the verbal-pictorial and inferential-pictorial correlation pairs fell short of conventional significance levels, so these points are quite speculative, but there appears to be some evidence that different mechanisms may be at work in the respective high and low stimulation-seeking groups. This exploratory moderator analysis should be extended to a further experiment specifically designed to test for such an effect, with larger N's in the various cells.

It may be concluded that the relations suggested by the correlational analyses were of the most use in pointing out directions for possible follow-up study in this area. The interaction of intrinsic and extrinsic arousal with instructional modes, learning modes, and types of learning materials is a large area in the study of motivation and learning, and one in which research is only beginning.

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Slide 1

Means and Standard Deviations for Dependent Measures in the Various Conditions of the Experiment

	Film Condition					
	High Structure		Intermediate Structure		High Structure	
Low stimulation-seekers	Mean	SD	Mean	SD	Mean	SD
N	15		14		11	
Inference subtest score	3.27	1.24	3.07	0.80	3.64	1.37
Verbal subtest score	6.07	2.20	5.21	1.78	4.64	1.43
Pictorial subtest score	4.40	1.31	4.71	1.18	3.27	1.54
Combined score	162.33	39.24	155.00	31.91	139.09	29.24
High stimulation-seekers	Mean	SD	Mean	SD	Mean	SD
N	15		14		11	
Inference subtest score	3.13	1.20	3.14	0.91	3.09	1.38
Verbal subtest score	6.27	2.14	5.71	1.39	6.00	2.00
Pictorial subtest score	4.67	1.95	4.93	1.67	4.73	1.42
Combined score	165.87	51.02	163.64	33.07	163.27	43.82

Slide 2

Correlational Matrices for Divided Data

Low Stimulation-Seekers	Inference	Verbal	Pictorial
Inference subtest	1.00		
Verbal subtest	.31*	1.00	
Pictorial subtest	-.02	.04	1.00

High Stimulation-Seekers	Inference	Verbal	Pictorial
Inference subtest	1.00		
Verbal subtest	.36*	1.00	
Pictorial subtest	.33*	.42**	1.00

*$p < .05$

**$p < .01$